Professional Development of Educators

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The National COSEE Network (NCN) has had a significant leadership role in enhancing ocean literacy across the country. Through broader impact activities that connect ocean scientists with formal and informal science educators, current ocean science has been integrated into exemplary education programs nationwide. In addition, through COSEE's partnerships with learning scientists, research based pedagogical strategies have been modeled for both scientists and educators. All Centers conduct these educator professional development (PD) activities that engage elementary through undergraduate educators, as well as those who educate the public in aquariums and science centers.

The professional development models used across the National COSEE Network (NCN) have been tested by the Centers, and are based on three main components:
1) Research - what is known from peer-reviewed literature
2) Evidence - evaluation data related to COSEE Center PD activities
3) Models – designs for COSEE PD that are tested and refined

Ocean scientists are active participants in COSEE's PD of educators by teaching, leading field and lab exercises, and providing research experiences for educators. The NCN supports these scientists by honing their communication skills and conveying their science to educators and the general public.

The NCN has identified effective practices for the key elements in this type of broader impact activity. To effectively engage ocean scientists, each Center management team should include at least one ocean scientist with an active research program, and Centers should have an active presence in their partner oceanographic research institutions. Ocean science graduate students have been found to be valuable participants in educator PD activities, and they can obtain much needed experience in communicating science. The most successful activities provide feedback to participating scientists on their effectiveness as communicators and educators. An example is the volunteer training program that COSEE Ocean Learning Communities provides for informal science educators and volunteer organizations throughout the Puget Sound region. Scientists present their results, and the educator participants offer them constructive advice for making their presentations more effective using a common rubric. The scientists are then able to discuss this with each other as well as the educators, and have consistently rated the experience as highly valuable. The educators leave these PD activities empowered with new and current scientific knowledge and feeling as though they have also contributed something valuable.

The NCN continually strives to expand its reach and sustain learning communities of scientists and educators. Common needs identified across the country are for scientists to address misconceptions in science, deliver geographically and culturally relevant content, and provide access to authentic scientific data. A key ingredient in facilitating learning communities that can satisfy these needs is the matching of scientists' expertise with educators' content needs. The delivery of ocean sciences content is best achieved by the modeling of inquiry-based activities, field experiences, research experiences, and other hands-on experiences that scientists are equipped to facilitate.

Centers have developed learning communities using technologies such as list-servs, blogs, and other on-line networking tools. An example is the COSEE Central Gulf of Mexico Teacher/Scientist Institute that promotes partnerships between research scientists and educators by offering many opportunities for the groups to interact following the initial PD program. This includes a subsequent three-week on-line institute featuring additional ocean science lessons that build upon what was covered in the PD program.

The COSEE Network strives to increase its engagement with educators and scientists from populations underrepresented and underserved in the ocean sciences through innovative partnerships and strategies in recruitment and engagement. Recommendations for broadening participation include the identification and recruitment of role models from underserved populations at all levels - scientists, teachers, students, and the general public – to participate in program activities. Many Centers are partnering with minority-serving institutions, multicultural organizations, and federal agencies that encourage broader participation in STEM disciplines. For example, COSEE Ocean Systems is partnering with the nationally recognized Institute for Broadening Participation to facilitate training across the Network to better serve the needs of diverse populations.

Many Centers require both participating scientists and educators to develop products that can be used to produce classroom lessons and activities either during or subsequent to the PD program. Examples of products include posters, websites, PowerPoint presentations, CD-ROMs, and on-line data and related products. Ensuring that the activities and products are of a high quality may require educators to adapt existing, tested activities rather than developing new ones, unless the program allows for field-testing of the activities. In most cases, scientists are involved in vetting the scientific content of the products and updating the content. Ocean sciences education materials developed through COSEE PD efforts are made widely available. One example is the wealth of material available on the COSEE West website (http://www.usc.edu/org/cosee-west/resources.html). These resources include archived online workshops on harmful algal blooms, coral reefs, polar regions, marine protected areas, ocean observing systems, and many other topics. Other resources include videotaped scientist lectures on a host of ocean sciences topics with glossaries of scientific terms and education lessons and activities.

The COSEE Centers fill an essential niche by assisting educators in interpreting ocean sciences content and transferring it to their classrooms by modeling how the content should be delivered; mapping the ocean sciences content to the national science education standards; demonstrating the personal relevance of ocean sciences; and engaging the educators with scientists in building scientific explanations and arguments. One successful example of this process is the Scientist/Educator Partnership program conducted by COSEE Coastal Trends (http://www.coseecoastaltrends.net/programs/scientisteducatorpartnership/). Teams of scientists, educators, and graduate and undergraduate students work together to provide science content to the educators as they engage in authentic research projects. The culmination of this six-week PD program is the production of a curriculum unit based on the research. The teams work together to ensure scientific validity and pedagogical integrity. These units are being incorporated into a new high school level ocean science course, "Introduction to Our Dynamic Ocean," that is based on the Ocean Literacy Essential Principles and stresses active learning through hands-on activities.

COSEE approaches its PD activities in a scholarly fashion, collecting front-end/needs assessment data to determine educators' current knowledge about the topics to be covered as well as their barriers to teaching ocean sciences. Annual evaluation results are incorporated into the next year's activities. Other evaluation strategies that are essential for assessing the impacts of COSEE PD activities are the engagement of evaluators in the activity planning stage; a daily reflection process that assists Centers with gauging the understanding of newly gained science concepts and participant needs; a focus on how tools/products are being utilized after the PD program; and opportunities for post-program scientist engagement.

It is also important for the COSEE PD programs to include mentoring components in program design. Mentoring may include several forms such as COSEE staff mentoring scientists by providing strategies for communicating science knowledge; COSEE staff mentoring educators through visits to their classrooms during the transfer of new content to their students, presenting together at conferences, and publishing collaboratively; scientists mentoring educators as they provide research publications for the educators to read pre-PD program and provide guidance post-program on further developing their understanding of the ocean sciences research enterprise; and educators mentoring educators as participants work together during and after the PD program, serve as leaders in their respective school or school districts post-program, return to mentor new participants in subsequent years, and mentor novice teachers.

Several models of educator PD are implemented by COSEE Centers. The main ingredients of COSEE PD models are the participation of ocean scientists, the integration of technology, pre-program orientation for the scientists, reflection time for all participants, the broad dissemination of education materials produced during the program and post-program "follow-up" with all participants. Four exemplary models have been field tested by COSEE Centers. One is the Scientist-Educator Summer Institutes, lasting from one week to six weeks, often followed by multiple online "follow-up" sessions. Another is Teacher Research Experiences (TREs) that provide laboratory or shipboard programs in which educators conduct authentic scientific research with scientist partners, followed by multiple online "follow-up" sessions. TREs are preceded by science content instruction for the educators and an orientation for the scientists. The Scientist-Educator Collaborative Workshop model is usually shorter in duration, lasting from two to six days followed by multiple online sessions. These workshops focus on specific scientific concepts or the use of a science education tool. Scientists deliver ocean science content through inquiry-based activities, concept mapping, and field or shipboard exercises. The fourth model is the Scientist-Educator On-line Workshop where participants interact in a virtual environment. On-line interaction is preceded by preparation of the educators and scientists to work in the on-line environment. In the case of all models, educators are required to develop or adapt education materials, transfer ocean science content to students or the public, and formally mentor colleagues post-program.

COSEE is transforming the landscape of educator professional development in the ocean sciences. Perhaps the most significant impact of COSEE's PD programs is the efficient and relatively rapid transfer of current, topical ocean sciences research to elementary through undergraduate classrooms and public venues across the country. The processes are considered, discussed, and evaluated Network-wide. Educators are The goal is to successfully equip educators to incorporate ocean sciences into their STEM courses and programs. The ocean

scientists report that their experience is rewarding, that they have improved their own teaching and communication skills as a result of their engagement, and that they are more likely to participate in broader impact activities in the future.

In September, 2009, the National COSEE Office facilitated a Network work session focused on the Centers' effective practices in the professional development of educators. This work session provided the opportunity for Center staff to share models, evaluation results, and effective strategies. A report from the work session can be found in the appendix. See Best Practices in the Professional Development of Educators.pdf